

COCAINE AS AN ANÆSTHETIC; ITS STATUS AT THE CLOSE OF
THE FIRST YEAR OF ITS USE.

At the meeting of the Ophthalmological Congress held at Heidelberg in September, 1884, at the request of Dr. Karl Koller, of Vienna, Dr. Brettauer, of Trieste, demonstrated that the hydrochlorate of cocaine had marked anæsthetic power upon topical application to the eye. The immediate wide publication of the results of these demonstrations awakened general attention to the properties of the drug as a local anæsthetic.

The leaves of the coca plant, called erythroxylon coca by Lamarck, have, beyond the memory of man, been used by the natives of South America and by the Rajpoots of India as a tonic stimulant and intoxicant, and preparations of them have been gradually finding their way into pharmacy. Gadecke in 1855 extracted an alkaloid from the leaves which he called erythroxyline and two years later Dr. Samuel R. Percy of New York discovered the alkaloid independently, exhibiting a specimen which he had isolated, to the New York Academy of Medicine, also giving it the name of erythroxyline, but it was not until 1860 that Niemann announced its physical properties and called it "cocain." Schroff observed that it had an anæsthetic influence on the mucous membrane of the tongue and Moreno y Maiz, in 1868, after experiments with the hypodermic injection of the acetate, observed, after ten minutes, distinct loss of superficial sensibility over a circumscribed area; the frog's sciatic nerve was exposed after fifteen minutes and sensation was found to be completely destroyed, from which he concluded: *Pourrait-on l'employer comme anæsthésique local*. In spite of this, the practical application of the drug escaped him. Rossbach, in 1880 remarked that as cocaine produced localized anæsthesia, further researches might prove of advantage, and Von Anrep in the same year noticed that the sensibility of the skin was abolished by hypodermic injections of solutions of the drug, that the tongue became numb when touched with strong solutions, and that it had a temporary mydriatic effect on the pupil.

Practical application to anæsthesia in surgery was, however, discovered by Dr. Karl Koller, of Vienna, Assistant Physician to the Vienna General Hospital, whose attention was called to the probable power of cocaine as a local anæsthetic by a study of the therapeutic action of the drug published in August, 1884, by Dr. Sigmund Freud. Surmising that if it paralyzed the terminations of the nerves of the mucous membrane of the tongue, it would probably have the same effect on the nerves of the cornea and the conjunctiva, he first experimented upon animals in the laboratory of Professor Stricker, and, emboldened by his success, extended his experiments to the human eye, using a 2 per cent aqueous solution of the hydrochlorate, and by his success, made one of the most positive additions to surgical knowledge of a century already notable for surgical progress.

The alkaloid, the composition of which has been determined by Losson to be $C_{17}H_{21}NO_4$, crystallizes in large four to six-sided colorless prisms; is bitter to the taste; benumbs the tongue like aconitine; is soluble in 704 parts of water at 12° C., readily in alcohol and still more readily in ether; and forms crystallizable salts readily by union with dilute acids. Among those prepared are the sulphate, nitrate, tannate, oxalate, salicylate, borate, citrate, tartrate, hydrobromate and the one best known to science—the hydrochlorate ($C_{17}H_{21}NO_4HCl$).

The hydrochlorate is the salt generally used and understood in the present article unless another is specified. Much of the salt in the market is more or less impure, of an amorphous character, varying in color from brown to yellow and adulterated with the alkaloids hygrine and ecgonine, also produced from the coca leaf. The pure salt consists of white or very slightly colored crystals—the facets evident in a strong light to the naked eye and readily perceived with a low magnifying power—perfectly soluble in water, producing a colorless solution and without odor.

Cucaïne, according to Sir Robert Christison is a preferable name for the alkaloid, since “cuca” shows the native pronunciation of the plant and, as well, serves as a distinction from other similarly named products. The objection to the name is certainly valid and a change would be an improvement, although a return to the original “erythroxyline” would be still better.

The German Pharmacopeia Commission has proposed the following description and tests for it :

Cocainum Hydrochloricum—A white crystalline powder of a weak acid reaction and slightly bitter taste, which produces a characteristic transient anæsthesia of the nerves of the tongue. It is easily soluble in water and in alcohol. It is likewise dissolved by nitric, hydrochloric and sulphuric acids, the latter causing a frothing. A solution of iodine produces in its aqueous solution a brownish red precipitate; the caustic alkalies produce a white crystalline precipitate difficultly soluble in water, but easily so in alcohol and ether.

Incinerated on a piece of platinum foil, cocaine hydrochlorate should leave no residue; it should be soluble without residue in double its weight of cold water, and should impart no coloration to mineral acids.

The experiments of Koller were made with a 2 per cent solution, but experience has shown that for general use, a 4 per cent solution is preferable. In some cases stronger solutions are required, particularly in the nose, pharynx and larynx, although repeated applications of a 4 per cent solution will often obviate the necessity of using the stronger ones. In some of the stronger solutions a more perfect solution may be obtained by the addition of a few drops of alcohol.

The aqueous solutions are apt to deteriorate by the growth of microscopic plants which are nourished by the alkaloid and destroy it. These growths, which, commencing within a week and increasing with some rapidity, may, when applied locally, produce severe inflammatory symptoms, are prevented by carbolic acid, the aromatic series, salicylic and boric acid, according to Squibb. Salicylic acid seems, on the whole, to be the best and most certain protective agent, and a good rule in making up solutions is to take one-half water and the remainder of a saturated solution of salicylic acid. This gives about one six-hundredth part of salicylic acid to the solution of the alkaloidal salt, a proportion which, while it is a sufficient protective, can hardly be objectionable in any way.

A still better method is to keep the salt in its crystallized state, preserved in capsules containing one grain each. An extemporaneous solution of the contents of such a capsule in a half dram of water, made in a moment when it is to be used, will provide with certainty a fresh and pure solution of nearly 4% strength.

A solution of the alkaloid in olive oil is serviceable for application

to the eye for recent abrasions from burns and other painful affections of the cornea. Moreover, it is not as easily carried off by the lachrymal secretions. It is of value as a lubricator in catheterizing sensitive canals—the urethra, œsophagus, trachea, etc.—and as an application in burns and superficial excoriations. The alkaloid is readily dissolved in oil by the addition of gentle heat in a water bath. Cocaïnized oil in a 5% solution can be obtained in the market. Oleate of cocaine would seem to meet the same indications. Bignon prefers cocaïnated vaseline for all external applications.

Gelatine discs impregnated with the hydrochlorate have been found by Joseph W. Warren to be of great convenience in the eye and in other moist cavities. The drug is also exhibited in the form of a spray, by inhalation and by insufflation. Eugene Smith considers the spray to be by far the most efficient mode of application to the eye. A spray-producer has been devised by Dunn expressly for use with cocaine solutions.

On all mucous membranes and on the cornea the topical application of a solution with a brush, spray or pipette will produce satisfactory superficial anæsthesia, but where anæsthesia of the skin or deeper parts is desired, it must be administered hypodermically. Bradford is the authority for a method of rapid cocaïnization of the eye by the instillation of a single drop of an 8 per cent solution at intervals of a minute. He was able to perform severe operations at the end of three minutes.

J. Leonard Corning, relying on the hypothesis that some time is required for the diffusion of the drug through the capillaries and that when the terminal filaments of the sensory nerves, which ramify in the saturated tissue, are exposed for a sufficient length of time to the influence of the cocaine, changes are induced in the nerve substance to an extent sufficient to interfere with conduction, causing local anæsthesia—relying on this hypothesis, he concludes that the same current which carries the drug to the nerve filaments will later dilute and carry off the anæsthetic substance; retardation of the movement of the blood from the anæsthetized part would then be sufficient to increase the duration of the anæsthesia. This result is best obtained by exsanguinating the part by Esmarch's bandage a few moments after

the injections of the drug, taking care not to compress the tissues immediately above the points of injection, and applying the tourniquet at a point on the lines beyond or within the site of the injections. By this method operations of considerable magnitude can be performed, although its application is apparently confined to the extremities, where compression can be obtained. It is believed that it will even be sufficient for amputations.

ACTION OF COCAINE.

Cocaine has a powerful local anæsthetic effect on the skin, mucous membrane, the eye and deeper structures. Laborde has found that the injection of one centigramme of the sulphate of cocaine in a 1 per cent solution produces greatly exaggerated movements in a Guinea pig, which are accompanied by anæsthesia, most distinct in the posterior extremities. A repetition of the dose, a few moments later, causes the movements to become wild and violent, while anæsthesia is present over the entire skin, although the conjunctiva apparently retains its sensibility, and the pupils are dilated; convulsions, both tonic and clonic, soon appear, contractions of the anterior extremities and of the muscles of the eye, evacuations of greenish fæcal matter and frequent micturition, passing into a condition of tonic opisthotonos. After a variable time this condition may disappear; to recur again until the animal finally appears to be entirely paralyzed, although again to be convulsed, and finally to completely recover, although the insensibility of the skin may last for forty-eight hours after the injection.

Von Anrep held that the convulsions were of cerebral origin, and arrested by section of the spinal cord. Dannini found that section of the cord did not arrest convulsions in the hind feet, and still other observers have reported that they were produced and continued after the medulla was divided, the question still remaining a mooted one.

The drug causes cerebral excitement and partial paralysis of sensibility in small doses; in larger doses cerebral excitement, complete paralysis of sensibility, tetanic spasms and death. There is paralysis of the posterior column of the cord and of the entire system of peripheral sensory nerves, although the anterior columns and the peripheral motor nerves are not paralyzed according to the extensive experiments of Alexander Bennett.

The depression of the irritability of the sensory nerves is preceded by a stage of increased functional activity. It would also seem that both the motor and sensory fibres are finally depressed, but that the action upon the motor is subordinate to that upon the sensory nerves.

It is held by some that the action of cocaine is exclusively local and anæsthetic, from the chemical affinity which it exerts through its presence in the tissues. The experiments of Halsted and Hall, showing that the injection of a drug in the course of a nerve anæsthetizes the parts to which it is distributed show that its action is centripetal, and probably due to inhibitory phenomena.

Pallor of the face, faintness, vertigo, syncope, and even slight convulsions have sometimes been observed to an alarming extent after the use of cocaine, and by Dujardin-Beaumetz they have been attributed to cerebral anemia. As poisoning is produced only by very large doses, these symptoms are hardly to be feared. Moreover it is possible that they may arise more from the hysterical apprehension of the patient, or possibly from some mental idiosyncrasy than from the effect of the drug.

Ziem, of Dantzic, in addition to a case reported by himself, has collected seventeen cases from ophthalmological literature, in which alarming effects have followed the local use of cocaine.

In three it was injected hypodermically, and in fourteen dropped into the conjunctival sac. The cases have been described by Peck (1), Mayerhausen (1), Stevens (1) Reich (2), Knapp (3), Heuse (4), and Bellarminoff (5). In some cases the symptoms have been transient, consisting of pallor of the face, giddiness, and sweating of the face or neck; in others there have been dyspnœa, great feeling of prostration, malaise and apathy, lasting sometimes for several days. Vomiting and headache have been rarely present. In one case the application of fifteen drops of a 2 per cent solution to the conjunctiva was followed by tottering gait, difficulty of speech, confusion of the mind, and extraordinary restlessness; and, in another, the subconjunctival injection of about eight drops of a 3.5 per cent solution produced convulsions and loss of consciousness. The strength of the solution used was 4 per cent in eight cases, 2.5 per cent in four, and 2 per cent in three or four others. The quantity generally varied from

two to four drops. The subjects were, in some cases, feeble aged women; in others they were strong and healthy individuals, both male and female.

The influence of the alkaloid upon the heart is, according to Beyer, exceedingly prompt and uniform; in small doses, it is a powerful stimulant to the heart's action; in medium doses, it has an inhibitory influence upon the ventricular contractions; and in large doses it produces diastolic arrest from which, however, the heart may be recovered under suitable conditions. A rise in the blood-pressure consequent upon the administration of cocaine is due to the direct action of the drug on the heart and blood vessels, stimulating the former and constricting the latter; a fall in blood-pressure, coming on after the rise, must be accounted for by the action of the drug on the heart alone since its constricting influence on the blood-vessels outlasts the stimulating influence on the vagus endings and also on the endings of the accelerator nerves of the heart, but has no stimulating action on its muscular substance. Other authors hold that a rise in arterial pressure is due to the contraction of the arterioles produced by the stimulation of the vaso-motor centre in the medulla, since Dannini has found that after section of the cord, cocaine is powerless to increase arterial pressure, and Ott that when the cord is cut in the cocaineized dog, the pressure falls to the level which it usually occupies in the unpoisoned animal. Whatever the cause may be the fact remains that the vessels are constricted by the application of cocaine.

Some observers have found no effect at all from cocaine upon striated muscles, but Biggs' experiments on the frog show that large doses diminish their excitability and those of Ott show that muscular contraction is prolonged.

The respirations are slightly increased in number at first, when the alkaloid is administered in small doses, and then diminished; by larger doses, they are rapidly decreased from the first, resulting in death by arrest of respiration.

Von Anrep observed that intestinal peristalsis was notably increased by moderate doses. The increase is followed by great sluggishness, deepening into paralysis after large doses.

According to Moreno it is eliminated by the kidneys. The secre-

tion of the urine and the elimination of urea is diminished, rendering it probable that tissue waste is decreased.

The skin temperature is elevated from the beginning and there seems to be a rise in the rectal temperature preceded by a fall, the elevation attaining the maximum during the convulsive stage.

Very large doses are required to produce death. Laborde places the fatal dose at 11 milligrammes for each kilogramme of body weight. A case is on record where twenty-two grains were taken with no permanent injury. When a toxic dose is taken, according to Laborde, the respiration is at first slowed, then accelerated, finally becoming irregular, frequent and intermittent, and in the last stage of the poisoning the respiration is again greatly accelerated, and death occurs in convulsions from asphyxia, while the heart may still beat regularly though feebly for one or two minutes longer.

APPLICATIONS OF COCAÏNE.

The drug is found to be useful as a stimulant in cases of bodily exhaustion, in digestive troubles, in the cachexiæ, as an aphrodisiac, in asthma and laryngeal phthisis, in the morphine, opium and alcohol habits, and as a local anæsthetic. It also has a decided hæmostatic action and in strong solution possesses marked antiseptic properties. Its anæsthetic action depends greatly upon the quantity and quality of the salt used.

GENERAL AND MINOR SURGERY.—Cocaïne has positive value in all operations upon superficial parts not requiring too much time, and it is probable that even this limit may be removed by Corning's method in operations upon the extremities. In cases of tenotomy for the relief of wry neck and other deformities, in operations for enlarged burse, tapping, injection of irritable matter, and excision, its use is indicated. In the removal of small tumors it has been shown to be efficient—in fatty and glandular tumors; cancerous ulcers and small tumors can be removed painlessly with arsenical paste and cases of excision of scirrhus and epithelioma from the face, breast and other parts have actually been reported. The case of General Grant, where it was of the greatest value in mitigating the pain of an epitheliomatous cancer of the base of the tongue, will occur at once to the reader.

In superficial plastic operations, particularly upon the face, in the removal of needles, bullets and other foreign bodies it affords great relief.

Fractured and dislocated bones may be examined and their displacements reduced painlessly through injections of cocaine made deeply at the site of the lesion (Conway). In other departments of bone surgery it has also been found useful. M. J. Roberts has reported a number of cases operated upon by Corning's method and the injection of cocaine into the skin, the soft parts and under the periosteum. It is applicable in relieving the pain in scraping away carious and excising necrosed bone, and in osteotomy for the relief of deformity, operations for which have been done by Roberts and Stillman. Its use in opening abscesses and other inflammatory tumors, carbuncles, paronychia, etc., would occur at once to the surgeon.

In relieving the pain of burns or scalds it has marked power, as well as in rendering painless the use of the thermo- and galvano-cautery. It will afford ample anæsthesia for operations upon the fingers and toes and for amputations of these lesser members if not for the major amputations. It is believed, however, that if the method of Corning be adopted it will be ample for all amputations, excisions and resections in the continuity of a limb. In the troublesome and painful little operations for ingrowing toe nail, many operators have found that it relieves all pain. In phlebotomy, vaccination, introducing trocars, and even in the ligation of arteries it will fully meet all indications for anæsthesia. In relieving the pain and reducing the inflammation of erysipelas it will be of value; and it has been found of service in cases of painful acute eczema, in relieving the pain of epilation, when rubbed in in the shape of the oleate, and Waugh has found it efficacious as a hæmostatic in a case of purpura with repeated hæmorrhages from the lips and gums where all other applications had failed.

GENITO-URINARY SURGERY.—The pains of gonorrhœa in both sexes and of chordee are relieved by the application of a cocaine solution, and it is claimed by some that the secretion is diminished. It is certainly efficient in relieving the pain attending the introduction of sound or catheter into a hyperæsthetic urethra. Rapid dilatation of urethral stricture, meatotomy and urethrotomy, both external and internal, are

rendered painless by the application of cocaine solutions. Caustic injections are relieved from pain by the same means. Condylomata can be painlessly cauterized, excised and scraped out with its aid, and the application of caustic in the treatment of venereal sores is relieved of pain. The suffering connected with the opening of a suppurating bubo is removed. Malcolm McLean has operated under the influence of a cocaine solution locally and hypodermically, upon a large and painful hydrocele, complicated with inguinal hernia, cutting into the tunica vaginalis and excising a considerable mass of thickened membrane, all without pain. It is indicated in catheterism, endoscopy, spasmodic retention of urine, prostatitis, lithotripsy and plastic operations on these organs and the application of caustics in venereal disease. Godson performed, without pain, under a 20 per cent solution, two operations for the removal of vascular growths from the female urinary meatus. Irritable bladder and urethra, and spasm of the sphincter vesicæ are relieved by local application.

It has been used in numerous instances to facilitate operations of litholapaxy with great success, and Weir has even expressed his belief that it would be sufficient for lithotomy. It is certainly of value in dilatation of the female urethra for the removal of calculi. It will be of value in strangulated hernia, both in affording relaxation of the tissues and anæsthesia for operation.

In preputial operations it is of great service. Milne has removed a tumor from the prepuce of an infant $2\frac{1}{2}$ months old, and in many cases it has relieved the pain connected with the detachment of adhesions of the prepuce. In the hands of numerous operators the hypodermic injection and local application of a 4 per cent solution have relieved the pain of circumcision.

Its value in affections of the rectum and anus is marked, from relieving pruritus ani to furnishing sufficient anæsthesia for the removal of growths from the rectum. It is indicated in rectal tenesmus and spasm from fissure or other causes, and is of value preliminary to the introduction of the rectal speculum, dilatation or cauterization of fissure. In fistula it affords ample anæsthesia for operations, and its service in all operations for the relief of hæmorrhoids is undeniable, as well as in case of reduction of prolapsus ani and the removal of vegetations.

GYNECOLOGY.—*Pruritus vulvæ* is allayed by the application of a cocaine solution, as well as the pain from fissures or excoriations at the vulva and the sensitiveness in spasm of the vulva. McLean removed a cystic tumor as large as a hen's egg from the labium minus absolutely without pain. The pain of vulvitis is mitigated, the opening of abscesses and cauterization of the vulva and the removal of the remains of the hymen are rendered painless.

In *vaginismus* the drug is highly useful from the fact that the reflex excitability of the vaginal orifice is diminished. Loewenthal removed a cancerous tumor of the vagina with the Pacquelin knife, using the actual cautery to arrest the hæmorrhage, with but little pain. Operations for fistulæ, vesico-vaginal, urethro-vaginal, recto-vaginal, etc., can be done without pain and with the active coöperation of the patient. Operations for lacerated cervix without pain are reported in numerous instances, and in these cases the solution should be exhibited both topically and by injection into the cervix. Polk has applied the actual cautery to carcinoma of the cervix extending to the vagina under cocaine. Blamely has found the local application of cocaine efficient in a case of ulceration and erosion of the os uteri and granular vaginal mucous membrane, where general anæsthesia had previously been necessary in order to introduce a speculum. It is also of value in introducing a sound or using the curette in the uterine cavity. Topical application to the cervix, the vagina, and vulva at the proper time with hypodermic injection into the cervix, as it dilates, very markedly diminishes the pains of labor. It has been found to be of value in performing perineorrhaphy, in tapping ovarian cysts, or in any explorative puncture.

Under the influence of a solution of cocaine locally applied, women subject to sore nipples are able to nurse, the soreness is relieved, and fissures, if not too deep, heal rapidly. Its use is advisable whenever the nipples are sensitive, in order to prevent fissures, which are often due to a shrinking movement of the mother when the child seizes the breast. It is of great value in rendering the opening of abscesses of the breast painless. Small tumors of the breast may also be removed under its influence.

THE EYE.—Following the line of Koller's experiments after the

demonstration of Brettauer, the drug was taken up with great enthusiasm by ophthalmologists. On the instillation of a 2 per cent solution into the conjunctival sac, a sensation of warmth is first felt, with an increase in the quantity of the lachrymal secretion; these disappear in about a half minute and are succeeded by a sensation of dryness of the eyeball; in from three to fifteen minutes sensation, both tactile and painful, is suspended in the conjunctiva and cornea, and the palpebral aperture appears to be widened. Complete anæsthesia lasts from seven to ten minutes, after which time sensation is slowly recovered, normal sensibility being regained after a period varying from a half hour to an hour and a half. During the period of complete anæsthesia all reflex irritability is abolished, the cornea and conjunctiva can be freely handled and blepharospasm and profuse lachrymation, its usual concomitants, are absent. Intra ocular tension is slightly decreased.

From five to twenty minutes after the instillation the pupils begin to dilate, attaining the maximum in from thirty to forty minutes, remaining stationary for about an hour, and gradually diminishing, the dilatation disappearing in a few hours more. Grove places fourteen hours as the limit of action of a 1 per cent solution and twenty-four hours as the limit of a 4 per cent solution. He also observed that the drug had a different effect upon irides of different colors, the dilatation not beginning in dark brown eyes until from ten to twenty minutes, usually about fourteen, while in the blue it never required more than ten minutes. The mydriasis is never extreme, but is sufficient for ophthalmoscopic examinations, and atropine will need to be used where extreme dilatation is desired. Observers vary as to the source of the mydriatic action, some holding that it is due to the presence of hygrine, but the balance of opinion seems to incline to the conclusion that it is inherent in the cocaine itself. Jessop considers it to be due to the local action of the cocaine as an irritant on the terminations of the cervical sympathetic nerve. This view is supported by the observations of Snell, that under general anæsthesia the pupil dilated by cocaine promptly contracts to its normal size.

The accommodation is affected to the extent of a shortening of the range and a slight recession of the near point, being reduced, but not

paralyzed. Knapp observed that the near point began to recede within twenty minutes after dropping a 4 per cent solution into the eye, increased for about the same period, after which it diminished. The accommodation not being paralyzed, the unpleasant feeling of blindness, resulting from atropine, is not produced. Bradford has observed that the mydriasis and effect on accommodation can be neutralized without danger by a mixture of ten drops of a 5 per cent solution of pilocarpine in a drachm of 4 per cent solution of cocaine.

Pallor of the conjunctiva, whiteness of the sclera and anemia of the posterior vessels are observed and attributed to the constriction of the vessels.

Perfect solutions have no appreciable effect upon the healing of wounds of the conjunctiva or iris, but it has the beneficial effect of all mydriatics upon the cornea, though to a less extent than atropine. The observations of Lucien Howe show that imperfect solutions produce a slight additional hyperæmia of the conjunctiva, and a perceptible abrasion of the epithelium of the cornea, delaying the healing process but slightly.

Mode of Application.—To secure anæsthesia of the eyelid the drug should be applied to the palpebral conjunctiva as for superficial operations upon the bulbar conjunctiva and the cornea, and three or four drops of an 8 per cent solution should be injected into and underneath the skin. Superficial anæsthesia of the eye is obtained by instilling three or four drops of a 4 per cent solution into the conjunctival sac, which has already been washed out with a 1:20 solution of boric acid. Three or four instillations of the same amount should follow during the next fifteen minutes and the first incision should be made immediately after the last instillation. The instillations should be repeated at intervals of five minutes during the operation. The use of a spray is of advantage here in applying the solution rather more effectively and rapidly than by instillation. In case the iris is to be incised, re-instillation should be made after the anterior chamber is opened, to secure the direct contact of the anæsthetic agent. Deeper structures are reached by injection with a hypodermic syringe. Reference has already been made to Bradford's method of rapid cocaïnization. Every

possible operative procedure upon the eye or its appendages has been successfully performed under the influence of the drug.

THE EAR.—Although the indications for the use of cocaine in aural surgery are not as many nor as marked as in ophthalmology, it is an important adjuvant to the therapeutics of the ear. In operations upon the auricle and external auditory canal, it is valuable as a hypodermic injection, while it is serviceable in controlling the pain of ulcers and granulations of the external meatus, applied locally. In tinnitus aurium a number of cases of relief by cocaine are published and Zaufal believes that he has obtained true anæsthesia of the tympanic membrane; acute myringitis has been relieved by the instillation of a 4 per cent solution. In otitis media a number of cases have been relieved from pain by the instillation into the external meatus, and still others by the insufflation of a solution through the Eustachian tube and by spraying the nares and then inflating the tube by Valsalva's method. It is proper to say, however, that Holt and others believe that, while cocaine relieves the pain and for a time holds the inflammation of otitis media in check, the congestion returns and is even prolonged after the effect of the remedy has passed off. Granulations of the middle ear were removed in two cases by Zaufal.

THE MOUTH AND PHARYNX.—The sensibility of the buccal and pharyngeal mucous membrane, including the tongue, and also the faculty of taste, are suspended by the application of cocaine. It is of great service in the operations for hare lip and in wounds of the mouth and promises to be of decided advantage in dental surgery.

Halsted and Hall found that the injection of a solution in the line of the sensory nerves of the teeth rendered the extraction of the teeth supplied by them painless.

The surgical treatment of salivary fistula is aided by the drug, as are operations upon the cheeks, such as that of the removal of a tumor from the inner surface of the cheek, which was accomplished without pain by Wyeth. The same surgeon also operated successfully for congenital cleft of the soft palate by painting a 4 per cent solution along the edges of the fissure, renewing the application every five minutes until the operation was completed.

It is useful as a palliative application in aphthæ and in ulcerations

of the tongue. Lower was able to stitch up a wound of the tongue in a child without pain. The pain and dysphagia of severe tonsillitis are temporarily relieved by cocaine applied locally, and its effect is highly beneficial in syphilitic tonsillitis, in stomatitis mercurialis and difficult deglutition. Phillips found it of service in tonsillotomy in lessening the hæmorrhage, abolishing the choking sensation and relieving pain. Its advantage in the surgical treatment of retro-pharyngeal abscess is evident; cauterization in pharyngeal catarrh is rendered painless under the application of an 8 per cent solution and the topical application of the drug to the pharynx prevents dyspnoea in tubage or catheterism of the œsophagus. The same procedure is of value in relieving the dysphagia of pharyngeal phthisis.

THE LARYNX.—It may be broadly asserted to be of the most positive value in all painful affections and operations of the larynx. As with the pharynx, the dysphagia from phthisical ulceration or inflammation of the larynx is readily temporarily relieved by cocaine. The best time for swallowing seems to be about five minutes after the application of the solution; phthisical cough has been relieved by inhalation and the irritable throat of phthisis has been soothed by the application of a 2 per cent solution.

Laryngoscopic examinations where, as in the majority of cases, the mirror is badly borne, are greatly facilitated by penciling the anterior and posterior surfaces of the soft palate, the posterior wall of the pharynx and the base of the tongue with a 20 per cent solution, repeated after a minute if necessary. That the removal of polypi and papillomata of the larynx is greatly facilitated is evident from the number of cases removed without any spasm of the muscles and without any sensation on the part of the patient after the fauces and trachea had been brushed with a solution of cocaine. It renders tubage of the larynx almost free from discomfort and Kohler sounded and even dilated the trachea under its influence. The spasms of chronic asthma can be relieved by painting the faucial mucous membrane with a solution, as has been done by S. E. Post.

THE NARES.—Upon the nasal mucous membrane cocaine has the usual anæsthetic effect, and, what is of fully as great importance, by the constriction of the vessels which it produces, it causes the col-

lapse of an engorged and swollen nasal mucous membrane. This is the source of its power over coryza and hay fever, many cases of which are relieved, although not cured, by its local application. Its influence over the nerve endings is seen also in the relief afforded in asthma and asthmatic coryza. Infantile coryza, or "snuffles," is also relieved by it. By suppressing venous congestion of the mucous membrane and by preventing reflex spasm it aids greatly in rhinoscopic examinations. By preventing secretion, hæmorrhage and sneezing it facilitates the employment of edged instruments within the nasal cavity and renders easy the removal of nasal polypi and the application of the cautery. Jarvis has removed portions of a deviated nasal septum and also portions of the turbinated bodies without pain and with but little hæmorrhage.

From this general retrospect the large and important place which has been established for cocaine within the year following its first public demonstration at the Heidelberg Congress is apparent.

As the sum of the whole, it may be said that, so broad is its application, and so frequently is it indicated by reason of its power to substitute ether and chloroform, and thus to do away with the disadvantages and dangers of these drugs, added to the fact that the patient is continued in consciousness while pain is prevented, it occupies the position of an ideal anæsthetic more nearly than any other drug now known.

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